SNAP BEANS for

marketing

canning

and freezing

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Snap Beans for Marketing, Canning, and Freezing[1]

By W. J. ZAUMEYER, *principal pathologist, Horticultural Crops Research Branch, Agricultural Research Service*

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IMPORTANCE OF THE CROP

Snap beans are one of the most popular vegetables known to have originated in the Americas. They have been very common vegetables in our gardens for more than 300 years. With the expansion of the growing of vegetables for market and of the canning and freezing industries since 1920, vast changes have occurred in varieties, geographical distribution, and cultural practices. The recent annual acreage of snap beans for market has been about 175,000 acres, and the acreage of those for canning and freezing about 120,000 acres. It is almost impossible to determine the amount of space planted to beans in home gardens and in market garden areas adjacent to large cities.

ADAPTATION

Beans are sensitive either to an alkaline or to a very acid condition of the soil. In general, they thrive better on mildly or moderately acid soils (pH 5.5 to 6.0) than on neutral or alkaline soils. If the soil is very acid the acidity can be corrected by applying lime, but precautions should be taken to avoid overliming. Too much lime may be quite as bad as too little, since too much may result in a deficiency

[1] Original edition was prepared by B. L. Wade, formerly principal geneticist.

of certain plant nutrients, such as iron and manganese. Snap beans do not thrive on strongly alkaline soils. On slightly alkaline or overlimed soils and an associated manganese deficiency in the southeastern coastal areas, about 300 pounds of sulfur per acre is satisfactory.

Snap beans will grow on both light and heavy soils, but it is generally conceded that beans do not produce well on very heavy soils. It is essential to supply plenty of fertilizer if the crop is planted on a very light soil.

Bean plants may drop their blossoms or pods during excessively hot or rainy weather. Varieties differ greatly in their sensitivity to weather conditions; so in many places growers find that they must determine by trial which varieties are best adapted to local conditions.

The States having the greatest acreage planted to snap beans for canning and freezing are New York, Maryland, Wisconsin, Arkansas, Florida, Michigan, Texas, Tennessee, Pennsylvania, and Oregon. Despite a relatively small acreage, Oregon ranks high in production, because of high yields per acre. For beans for marketing fresh, Florida is the leading State, but North Carolina, New York, Louisiana, New Jersey, California, South Carolina, Virginia, Texas, Georgia, Maryland, Mississippi, and other States ship large quantities to established markets. Nearly every large city is at least partially supplied with market-garden beans by short-distance hauls at some time during the summer season.

VARIETIES

Until 1894 most varieties of snap beans were stringy and of only fair to medium quality. In 1894 the first conspicuously successful stringless bean was introduced as Burpee Stringless Green Pod, and the majority of varieties introduced since have been stringless. Some old favorites of the stringy type are still in use, but their popularity is steadily decreasing.

Because the materials and labor for growing pole beans are expensive, varieties of this type are not grown to the same extent as are bush beans, except in home gardens and in a few canning areas in the western United States where the extra cost of handling is more than offset by the yield and price. Some strains and varieties of pole beans are also used for freezing, and a large acreage is grown commercially in California and Florida for market use.

Snap beans occur in two natural classes, green-podded and wax-podded, of which the green-podded is the more important. Pods of wax beans show mechanical injuries and disease spots very plainly; and so they have been discriminated against to some extent by both growers and consumers. However, there is usually a good market for wax beans if they can be grown satisfactorily, since many consider wax beans to be of particularly desirable flavor.

Green-Podded Bush Beans

In the stringless, green-podded bush class the most popular variety for shipping is Asgrow Black Valentine, often called Stringless Black Valentine (fig. 1). The pods of Asgrow Black Valentine are about 6 inches long, oval, nearly straight, narrow, dark green, and stringless. A round-podded Black Valentine was listed by some seedsmen several years ago, but it did not prove popular as a market bean.

Figure 1.—Asgrow Black Valentine, a popular shipping variety.

Contender, a new fresh-market type, is somewhat similar to Asgrow Black Valentine, but under most conditions the pods average ¾ of an inch longer and are slightly heavier and thicker and not usually as straight. The pod shape of the small sizes is a plump oval; however, pods of the larger sizes approach round and are generally classified as off-round. This variety is widely adapted, a high yielder, and is resistant to common bean mosaic.

In many localities Bountiful, only a few years ago one of the most popular of the stringless, green-podded bush group, outyields Asgrow Black Valentine but not Contender. Bountiful is a flat-podded type with light-green pods. Plentiful is also a flat-podded variety, which in some areas and seasons gives even higher yields than Bountiful. The pods of Plentiful average slightly larger and slightly darker green than those of Bountiful.

The varieties so far discussed are stringless, but there is some side-wall fiber in them; to produce a satisfactory product pods should be picked before they reach full size.

In the round-podded class of the stringless, green-podded bush beans, Tendergreen, also known as Asgrow Stringless Green Pod and New Stringless Green Pod, until very recently was the most popular. Some of the new varieties that are gaining in popularity and which might replace Tendergreen are Tenderlong 15, Improved New Stringless, Topcrop, and Wade. Tenderlong 15 and Improved New Stringless are quite similar to Tendergreen and in addition are resistant to common bean mosaic. Topcrop (see cover illustration) is also in the Tendergreen class, but its pods are not so dark green as those of Tenderlong 15 and Improved New Stringless. Topcrop is mosaic-resistant, a few days earlier than the above varieties, and is widely

adapted. Wade is another mosaic-resistant variety with very dark, smooth, round pods of Tendergreen length (fig. 2). It is slightly later than Tendergreen. Because of its recent introduction, its adaptation is not well determined. Full Measure, which resembles Tendergreen rather closely, is still grown for its yield and color in some places, but elsewhere it does not yield so well as Tendergreen. Other recently introduced varieties that resemble Tendergreen are Supergreen (fig. 3), Slendergreen, Logan, Rival, and Processor, the last being white-seeded.

Figure 2.—Wade, a recent All-America winner that belongs to the round-podded class.

Giant Stringless Green Pod is still used to a limited extent for canning as cut beans, but its popularity is declining. Burpee Stringless Green Pod, somewhat similar to Giant Stringless Green Pod, has been largely replaced by a selection from it known as Landreth strain of Burpee Stringless Green Pod. It is frequently called Stringless Green Pod. This variety remains very popular with home gardeners.

Asgrow Black Valentine, Contender, Bountiful, and Plentiful are used mainly for shipping and market. Bountiful and Plentiful are used to some extent for "French style" beans. Tendergreen, Tenderlong 15, Improved New Stringless, Topcrop, Wade, Full Measure, Giant Stringless Green Pod, and Landreth Stringless Green Pod are used not only for marketing and home garden but also for commercial canning and freezing.

Despite their high quality for canning, the mosaic-resistant Refugee types, such as Idaho Refugee, Sensation Refugee 1066, Sensation Refugee 1071, and U. S. 5 Refugee, are rapidly losing popularity, because the pods are more difficult to pick and are not so dark green as most of the varieties in the Tendergreen class. They have a semi-

Figure 3.—Supergreen, a mosaic-resistant variety that resembles Tendergreen.

indeterminate type of plant, and have medium-long, straight, light-green pods of mild flavor and very little fiber. They are about 2 weeks later than Tendergreen. They are not used as shipping and home-garden beans but as canning varieties in a few of the northern sections, especially in Wisconsin where they are well adapted.

Ranger, a white-seeded canning variety, is a half-runner type that is mosaic resistant. The pods are produced very close to the ground. The high-quality pods are produced in great numbers and are not so concentrated in season as varieties like Tendergreen and Topcrop. The dry beans may also be used for baking. Dixie White, Spartan, and State are also half-runner varieties and are used in some southern areas.

Wax-Podded Bush Beans

Wax-podded beans are occasionally grown for home garden use and are grown rather extensively for shipping and processing. Almost any flat-podded wax variety may be sold on the market as Bountiful Wax, but the variety that is most frequently sold under this name is Sure Crop Wax. This variety is early, productive, and has deep-yellow stringless pods. Cherokee Wax is a recent introduction and is gaining much popularity as a shipping variety. It closely resembles Asgrow Black Valentine except for pod color. Its pods are long, oval, stringless, and have a deep-yellow color.

Among the stringless round-podded wax beans, Brittle Wax (Round Pod Kidney Wax) has been the principal canning variety, both as a cut bean and packed whole. It has the same season as Sure Crop Wax. One objection to Brittle Wax is that it usually does not yield well under adverse conditions. Since 1945 Kinghorn Wax, identical

in all respects with Brittle Wax except that it has white seeds, has become exceedingly popular. Improved Brittle Wax, very similar to Brittle Wax except that it is resistant to mosaic, was introduced recently.

Puregold Wax has medium-long, slim, round, golden-yellow pods and is well adapted in some canning areas. It is resistant to common bean mosaic. Rogers Sensation Wax No. 1 is principally used for canning whole. Its pods have a deep golden-yellow color and are slimmer than Brittle Wax. Improved Kidney Wax is similar to Brittle Wax but its pods are oval and contain a little more fiber.

Pencil Pod Black Wax is of very high quality, but the black seeds have caused it to lose favor as a canning bean. It is still grown for home and market. In some areas, its yields are high in comparison with those of other varieties, but in general in the South they are low.

Pole Beans

The pole variety, Blue Lake, contains a number of strains differing somewhat in pod size, season of maturity, and use. They are late beans, in season with Refugees, and have white seeds. In western United States (Utah, Washington, Oregon, and California) and in Texas, they are extensively grown for canning and freezing. Some are packed "asparagus style" and the quality and appearance have resulted in good prices. The main pack of Blue Lake types is probably cut beans. The pods are dark green, relatively low in fiber content, and oval, approaching round in cross section. The pods of the original or regular Blue Lake variety are stringless only when young and are shorter than the newer strains, all of which are stringless in all stages of maturity. Most strains of Stringless Blue Lake are full round podded.

All of the Blue Lake acreage for canning and freezing is grown under irrigation and poled, but for seed it is not poled. The yields of this variety under western conditions are usually very large; many farmers in Oregon average 7 to 8 tons per acre of canning beans. Yields of 10 to 11 tons are not uncommon.

Kentucky Wonder, known under various other names, is the most widely grown of the large-podded, late pole varieties. Some lines are stringless when young but develop prominent strings later. Others are stringless throughout the marketable stage. The pods are very long (6 to 10 inches), rough, fairly thick, and wide, almost round at maturity. The Kentucky Wonders are mostly used as home and market-garden beans. Varieties similar to Kentucky Wonder, such as White-seeded Kentucky Wonder, Burger Stringless, McCaslan, and various rust-resistant strains of similar type, are also grown for home and market-garden use. So-called bush types of Kentucky Wonder, such as Commodore or Improved Commodore, have been introduced but have not as yet attained popularity.

Ideal Market (Black Valentine Pole or Black Creaseback) is a fairly early pole bean for the southern United States. The pods are long, round, slender, and dark green and stringless when young, but they have very strong strings later. The quality of this variety is very good. Alabama No. 1 resembles Ideal Market but is very resistant to root-knot nematodes. Canfreeze is another new black-seeded pole variety. McCaslan and Striped Creaseback still remain popular, however, in southern areas.

Varietal Trends

For home use, the best variety to use is the one known to succeed in that locality. In the case of growers who produce beans for market or canning, it is sometimes not so much a question of what varieties will do well as of what varieties can be sold.

Unlike many other crops, most of the varieties of beans can be and are frequently used for dual or even triple purposes. In some cases market-garden growers plant a larger acreage than they really hope to dispose of as market-garden beans with the expectation of selling the surplus to canning factories. In such cases the canners determine the variety or varieties that will be offered on the local market as a fresh vegetable.

Increase in sales of dark-green, quick-frozen beans has perhaps been one of the most important reasons why both canners and freezers are now demanding round-podded, dark-green beans with a minimum of fiber. Tendergreen, until 1952, increased rapidly in favor at the expense of Landreth Stringless Green Pod, Bountiful, Giant Stringless Green Pod, and Full Measure.

The quality of the Refugee varieties is unquestioned, but apparently consumers are finding the dark-green pods of Blue Lake more attractive. Furthermore, bean pickers do not like to pick Refugee beans nearly as well as they do beans of varieties that have a more concentrated pod set. When the mechanical bean harvester is perfected and in wide use (fig. 4), varieties with an indeterminate bush habit and a lack of pod concentration such as the Refugee varieties will no longer be popular for commercial culture.

Since the relatively spectacular success of the white-seeded Blue Lake, canners have been requesting the development of other white-seeded canning types. In cut beans with colored seed there is often a slight but noticeable coloration of the seed at the canning stage. For example, Brittle Wax, which has a deeply colored eye, and Refugee and Giant Stringless Green Pod, which have colored seeds, sometimes show this discoloration. The only reason why Kinghorn Wax has gained such rapid popularity among canners is because of its white seed, even though it is identical with Brittle Wax in every other respect.

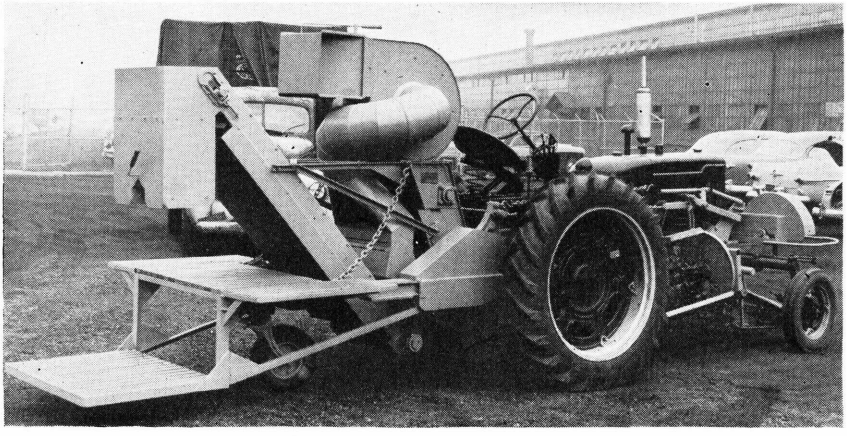

Figure 4.—A snap bean harvester that was developed recently.

The introduction of stringless varieties has been the cause of much of the great increase that has occurred in the bean-processing industry since the 1920's; and the insistence of the industry upon certain snap bean characters has resulted in a great stimulus to bean breeding. In some seasons growers experience tremendous financial loss due to diseases caused by viruses, fungi, or bacteria. As a result, new varieties, to become successful, should also possess resistance to one or more of the important bean diseases.

Season of Maturity

In the descriptions of varieties no mention is made of the number of days to maturity, i. e., to marketable size. This is because the maturity date varies considerably from one locality to another and from one season to the next. Ordinarily, a grower would expect to be able to pick pods from a plant within 2 weeks of the appearance of bloom; yet, in extremely hot weather, if there is a scarcity of available moisture during the flowering period, many sets of blossoms may drop off and it may require as much as 6 weeks from the first bloom to the edible stage. On the other hand, cool weather may result in delayed development of pods that have already set. Early varieties such as Stringless Black Valentine and Brittle Wax reach a marketable size in 50 to 55 days after planting under a wide range of conditions in Colorado, New York, and South Carolina, while the mosaic-resistant Refugees are about 2 weeks later. Pods are usually ready for harvest within 2 weeks of first bloom.

PLANTING AND CARE

Rotation

The frequency with which beans occur in the rotation is at least somewhat dependent on the occurrence of soil-borne diseases. Where root rots and other diseases do not give much trouble, beans may safely be planted in 2 years of a 5-year rotation. Where root rots are troublesome, beans should not be planted on the same soil more than once in 5 years.

Fertilization

Contrary to some popular notions, beans do well on fertile soils. Since the bean plant lives for only a relatively short time, it is preferable to supply fertilizers that are quickly available. A moderate application of a complete fertilizer, such as one analyzing 5 percent nitrogen, 15 percent phosphoric acid, and 5 percent potash, is usually of some benefit, but it is best to follow fertilization practices that are based on the known actual requirements of the soil. The precaution that is really necessary in planning fertilization of beans is to make sure that an excessive amount of nitrogen is not supplied. When too much nitrogen is supplied, the vine growth may be heavy, but the yield of pods may be disappointing. In some southern areas where leaching occurs readily on very light soils it may be necessary to make one or more side dressings of a nitrogeneous fertilizer. The complete fertilizer should be put into the soil approximately 2 weeks before planting the seed in order to avoid fertilizer injury. Applications of fertilizer in bands, 1½ to 2 inches to the side of the seed and 1½ inches below it, are recommended for Virginia and South Carolina if the

equipment is available. In New York, Florida, Louisiana, Massachusetts, and West Virginia also good results have been obtained with band placement.

Inoculation

The artificial inoculation of bean seed with nitrogen-fixing bacteria is generally unnecessary. Tests in New York and Michigan do not indicate that inoculation is justified on either new or old bean soil, but in some of the Western States inoculation of seed for areas that have not been previously cropped to beans is recommended. In using inoculum, the grower should follow the directions supplied with it.

Seedbed Preparation

The seedbed should always be well prepared and free from clods; otherwise, many of the young plants will die before they are able to push their way through the clods. In case of rains, which may result in a crust forming on some soils before the plants are up, it may be necessary to break the crust to obtain a good stand. Although bean plants have a fairly extensive root system, they do not appear to be gross feeders and hence are unable to compete successfully for their share of soil nutrients on spring-plowed sod. If beans are to follow a sod crop, the field should always be fall-plowed. Beans in the rotation should preferably follow some cultivated crop with a more vigorous root system.

In areas of heavy rainfall beans are usually planted on raised beds in order to obtain adequate drainage. In areas where row irrigation is practiced the necessary construction of water furrows results in a slight ridging of the soil at the base of the plants. In areas of moderate rainfall and in those where overhead irrigation is used, raised beds or ridges are rarely used. In dryland areas, listing, the opposite of ridging, may be necessary.

Time of Planting

Since beans are very sensitive to cold weather, it is essential to plant them only after the soil has become fairly warm in the spring, preferably after danger of frost is past. In the South it is also necessary to plant at such a time that the plants will not be exposed to either too hot or too cold weather at podding time.

Rate of Planting

Planting rates vary, depending on germination of seed and locality of planting, and to some extent on variety. In general, western and northern growers plant less seed than southern. In the canning areas of Wisconsin and in the canning and market-garden areas of Colorado, 20 to 30 pounds per acre is considered sufficient; but in Florida, planting of market-garden beans at 60 to 180 pounds per acre is general. In South Carolina, 60 to 75 pounds per acre is recommended. The ability of bean seed to germinate is lost very quickly if it is stored under hot, humid conditions. Many southern growers are able to reduce the rate of planting by having the seed shipped in by express as needed or by having it held in air-conditioned storage before planting. Where rains are generally expected at planting time it is a common practice to increase the rate of seeding,

since rain within 48 hours after planting usually interferes, to some extent, with germination. When good germination is obtained, the very high rates of seeding may actually reduce the yield per acre, and they always reduce the yield per plant. Up to about 125 pounds of seed per acre will probably increase the total yield per acre over a 40- to 65-pound rate at some places in the South, but the increase in yield may not be worth the cost of the extra seed.

Depth of Planting

Depth of planting should vary with type of soil, temperature, and amount of moisture available. Beans are ordinarily planted rather shallow, ½ to ¾ inch, on heavy soils and deep, 1½ to 2 inches, on light soils. Under South Carolina conditions on light Coastal Plain soils it has been shown that increased depth of planting up to 2 inches resulted in somewhat better stands than ½-inch depth, but that infection with the dry root rot organism increased with depth of planting. Such infection did not decrease yield under the conditions of the experiment. Beans should be planted deep enough so that they will be in contact with sufficient moisture for uninterrupted germination. To obtain sufficient moisture in some cases, it may be necessary to furrow out to a depth of 4 to 6 inches but to cover to a depth not exceeding 2 inches, depending upon soil type and temperature.

Spacing of Rows and Cultivation

Distances between rows generally vary from 24 to 48 inches. The shorter distances are common in irrigated regions, and those from 36 to 48 inches in regions that depend upon rainfall.

Beans should be kept free from weeds; however, more than three or four cultivations are usually unnecessary, and in some places only two may be required. Cultivations should be shallow and should be discontinued before the plants become large enough to be injured by the process. In some sections of the South, where beans are planted on fairly high beds, it is the custom to follow cultivation with a sweep 14 to 18 inches wide to move the soil up close to the base of the plants and to help maintain the beds, which may undergo considerable washing down by heavy rains.

Irrigation

In irrigated areas it is good practice to have the soil sufficiently moist prior to planting so that it is not necessary to irrigate until after the crop is up. Frequency of irrigation is determined largely by the rate of evaporation. Beans should not be permitted to suffer from lack of water to the point where they become dark green in color. When this occurs, the resulting crop usually does not come up to expectations. It is especially desirable to supply plenty of moisture at blooming time, for if this is not done the set of beans is apt to be very limited. If no rainfall occurs, it usually requires from four to six irrigations to bring beans to the marketable stage.

In many irrigated sections it is the practice to irrigate only every other furrow. This practice results in good aeration, since the odd-numbered furrows are used for one irrigation and the even for the next irrigation. It also has advantages at harvesttime, since it is not necessary to wait for the ground to dry out to use machinery.

DISEASES AND THEIR CONTROL

Important Diseases

Beans are attacked by a large number of diseases. Some of them may cause serious injury and reduce both quality and yield. They may kill the seedlings, injure or kill the growing plants, or may spot and decay the pods and seeds. Some of the diseases are limited by climatic conditions and certain insect carriers and hence are not found in all bean-growing areas. Brief descriptions of symptoms and control recommendations are given here for several of the more common diseases. More complete information is given in Farmers' Bulletin 1692, Bean Diseases and Their Control.

Bacterial blight is readily recognized in the field. It is most noticeable on the leaves but later attacks the stems and pods. Diseased leaves first show water-soaked spots, which rapidly enlarge, turn brown, and finally kill the leaf. Sometimes all the leaves are destroyed in this manner. On the pods, the disease causes water-soaked or greasy-appearing spots that later become slightly sunken and often are covered with a dried bacterial ooze. The "hinge" or upper suture of the pod may also become discolored and a water-soaking of the tissue on both sides of it is often noted.

Anthracnose is most noticeable on the pods in the form of sunken cankers that may develop either before or after the beans are picked for market. During moist weather spores are produced within the cankers which have a somewhat pinkish color.

Common bean mosaic causes mottling, curling, crinkling, and malformation of the leaves. In some cases pods are mottled, deformed, or rough. Diseased plants are often dwarfed and unproductive.

Powdery mildew is more abundant in the Southern States and along the Pacific coast than elsewhere. The disease is first noticed as small, white, powdered spots, which enlarge and coalesce with others to form a coating of a whitish, chalklike powder over the leaf. Infected leaves turn yellow and if the attack is severe they fall off. Infected pods may be stunted, malformed, and poorly filled.

Bean rust attacks principally the leaves. The first symptoms appear as small, white spots or flecks that develop into rust-colored lesions about the size of pinheads a few days later. These lesions contain thousands of spores, which are readily spread by wind or rain over wide areas. A week or so after these appear the leaf turns brown, dries up, and falls from the plant.

Several different organisms may cause root rots of beans. The symptoms are so similar that sometimes it is difficult to tell them apart. Root rots occur wherever beans are grown, but on the whole they do more damage to the crop in the Southern States. Root rots as a group are characterized by the formation of cankers on the stem below the soil line and on the fibrous roots. Infected seedlings may be killed and older plants are often stunted and their leaves turn yellow.

Watery soft rot, or white mold, affects the stems, leaves, and pods. First small, soft, watery spots appear. These often girdle the main stem and branches, causing them to wilt and die. If several days

of warm wet weather follow the infection, a cottony growth spreads over the infected spots. Later small, hard, black bodies, called sclerotia, looking like bits of charcoal appear within the infected spots and in a few days the plant usually dies. Mold on infected bean pods in shipping baskets cause the pods to stick together and is referred to as "nesting."

Root knot is mostly found in the South and in California. Root knot is characterized by enlarged, irregularly shaped, fleshy galls on the root system. Sometimes the galls may be confused with the nodules that develop on the roots of beans, lima beans, and other legumes. Root knot should be suspected when the leaves are pale, and the plants are dwarfed and begin to die.

Disease Control

If inoculation of the seed to supply nodule bacteria to the plant is considered necessary, the inoculum should not be applied with water, since certain seed-borne diseases such as anthracnose and bacterial blight may become distributed to many of the seeds that would otherwise produce healthy plants. Anthracnose and bacterial blight can be avoided usually by using seed grown in certain Western States where these two diseases seldom occur. Mosaic can be prevented by growing mosaic-resistant varieties, of which there are quite a few. Control of insects is related to control of diseases because many insects spread diseases from plant to plant and from one field to another.

Rust and powdery mildew can be controlled by sulfur dust, provided the treatment is not delayed too long.

Root rots and watery soft rot are so closely associated with weather conditions that they cannot be prevented entirely. Insurance of proper soil drainage and practice of a 4- or 5-year crop rotation will lessen the damage caused when conditions are otherwise favorable for these diseases.

If bean straw or manure from bean straw is spread on fields, it is usually best to avoid placing it on fields to be planted to beans the next season.

The most satisfactory control for root knot is to rotate with immune crops for 3 years or more.

Seed Treatment

Treatment of seed with various chemicals has been recommended and to some extent practiced as a means of disease control. The results have been too variable and uncertain to recommend as a general practice. The most beneficial results are likely to be obtained in very early plantings if the soil is wet and cold. Under such conditions the disinfectant may protect the seed from rotting until it has a chance to germinate. Dusting the seed with Spergon at the rate of 1½ ounces per bushel or with Arasan at a rate of 1½ to 2 ounces is recommended. On the other hand, seed treatment is likely to be of little value if the weather is sufficiently warm and otherwise favorable for quick germination.

INSECTS AND THEIR CONTROL [2]

The more important insect enemies of snap beans include the Mexican bean beetle, potato leafhopper, and the seed-corn maggot.

Precautions

Most insecticides are poisons. Handle them with great care. Follow the directions on the labels. Store all insecticides in closed containers where they cannot be mistaken for food or medicine, and where children or farm animals cannot reach them. See that the containers are properly labeled.

Parathion is extremely toxic if swallowed, inhaled, or absorbed through the skin, and may cause death. It should be applied only by a trained operator, who will assume full responsibility and enforce the precautions prescribed by the manufacturer. It should not be applied to snap beans within 21 days of harvest.

Do not apply CS–708 or DDT after the pods have begun to form or on vines that are to be fed to milk animals or to meat animals being finished for slaughter.

Mexican Bean Beetle

The Mexican bean beetle is copper colored with 16 black spots on the back. The larvae are yellow and covered with spines, which gives them a fuzzy appearance. Both the beetles and the larvae feed on the underside of the leaves but leave the upper surface intact (fig. 5).

Several insecticides will protect beans from injury by the Mexican bean beetle. Rotenone is the most consistently effective material that is not hazardous to the person applying it, and does not leave harmful residues on the plants. The new insecticides methoxychlor, malathion, parathion, and CS–708 (Dilan) are also effective. All these insecticides may be applied in either sprays or dusts.

Rotenone is the active ingredient in derris and cube powders or extracts. For a spray use 2½ pounds of a powder containing 5 percent of rotenone, or its equivalent, in 100 gallons of water (2½ level tablespoonfuls per gallon), or sufficient extract to make a spray containing 0.015 percent of rotenone. If you use a powder that is not wettable, mix some of it with water to form a paste, before adding the remainder of the water. Do not use low-strength rotenone dusts to make sprays, for they may clog the nozzles. For application as a dust, use a ready-prepared rotenone dust containing 0.75 to 1 percent of rotenone.

Methoxychlor may be used in a spray at 2 to 4 pounds of 50-percent wettable powder per 100 gallons (2 level tablespoonfuls per gallon) or in a 5- to 10-percent dust. A dust containing clay as the diluent gives better results than one containing pyrophyllite.

Malathion is effective in a spray at 4 pounds of 25-percent wettable powder per 100 gallons of water (2½ level tablespoonfuls per gallon) or in a 5-percent dust. Do not apply malathion to beans within 14 days of harvest.

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[2] This section was prepared by D. J. Caffrey, entomologist, Entomology Research Branch.

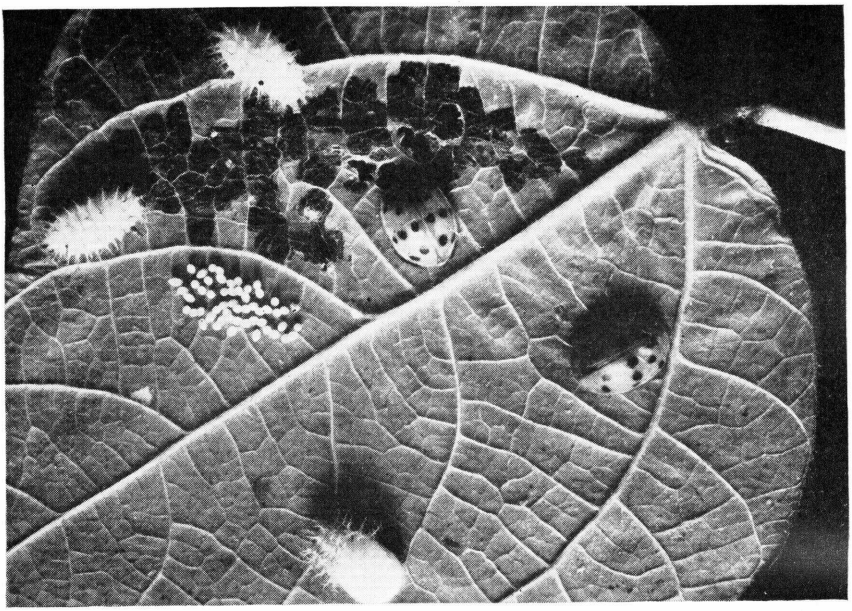

Figure 5.—The eggs, larvae, pupa, and adults of the Mexican bean beetle on a bean leaf.

Parathion may be used in a spray at ½ pound per 100 gallons (2 pounds of a 25-percent or 3 pounds of a 15-percent wettable powder) or in a 2-percent dust.

CS–708 (available commercially as Dilan) is effective in a spray at 1 pound of 50-percent wettable powder per 100 gallons (1 level tablespoonful per gallon) or in a 2-percent dust.

The bean beetle is not difficult to control if the insecticide is applied to the underside of the leaves, where the larvae feed. Applications to the top surface of leaves are a waste of time and material. One should watch for the first appearance of the beetles and begin control measures as soon as the first adults or egg masses are found. It will be too late to prevent appreciable damage if treatment is delayed until injured foliage is readily apparent in the beanfield.

Potato Leafhopper

The potato leafhopper is a small green insect that feeds on the underside of the bean leaves, sucking the juices from the tissues. In feeding it injects into the plant a toxic substance that causes a curling of the leaves and stunting called hopperburn.

A dust or spray containing parathion or methoxychlor will control the potato leafhopper on beans, when used in the same manner as recommended for control of the Mexican bean beetle.

DDT is also effective against this leafhopper. For a spray use 2½ pounds of 50-percent wettable powder in 100 gallons of water (2½ tablespoonfuls per gallon). For a dust use the 3-percent strength.

Seed-Corn Maggot

The seed-corn maggot is the legless white larva of a fly that is slightly smaller and more slender than the house fly and the same color. Only the larva, or maggot, is destructive. It attacks the germinating bean seeds or the seedlings in the soil. It may destroy the seeds before the seedlings can emerge, or it may only injure the seedlings and make them unproductive. This insect is especially destructive in the spring in cold, wet soils and in soils containing large quantities of decaying plant or animal matter.

The seed-corn maggot can be controlled by coating the seeds with a thin paste, or slurry, containing an insecticide and a fungicide mixed with water. The slurry is likely to injure the seed unless sufficient fungicide is included. For the insecticide use a wettable powder containing 75 percent of aldrin, dieldrin, or lindane specified to be free of solvents. For the fungicide use a 75-percent thiram wettable powder that was prepared by the manufacturer especially for slurry treatment.

To prepare sufficient slurry to treat 100 pounds of seed, mix ⅓ ounce (4 level teaspoonfuls) of the insecticide with 1½ ounces (9 level tablespoonfuls) of the fungicide and 8 fluid ounces (1 cupful) of water. Let the mixture stand 5 or 10 minutes before treating the seed.

To treat small quantities of seed, stir the slurry well and use ½ teaspoonful per pound of seed. In treating the first batch about 10 percent of extra slurry will be needed, as part of it will stick to the inside of the container in which the seed is treated. Place the seeds in any smooth container that can be tightly closed, but do not make it more than half full. Scatter the slurry over the seeds, close the container, and then roll and tumble it until the seeds are thoroughly coated. Then remove the seeds from the container and place them in a cloth sack to dry.

If more than 1,000 pounds of bean seed are to be treated regularly, it is best to use a slurry-treating machine. With this machine all the seed receives the same amount of chemical coating. Add 6 ounces of the insecticide wettable powder and 1½ pounds of thiram concentrate to 1 gallon of water. This quantity will coat about 1,800 pounds of bean seed. Use this mixture according to directions for use of the treating machine.

As a substitute for a slurry treater, a clean cement mixer may be used. Measure out ½ pint of the slurry previously described for treating 100 pounds of seed. Turn the cement mixer only long enough to coat the seed. Too long or too rapid mixing may damage the seed.

Do not plant beans in soil containing large quantities of decaying plant or animal material. Allow 3 weeks or more after the application of animal fertilizer, or after the turning under of green plant material. Before planting see that there is about an inch of dry, well pulverized soil on the surface. The dry soil is unattractive to to seed-corn maggot flies for depositing their eggs.

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